THE DAILY VARIATION OF TEMPERATURE IN THE LOWER STRATA OF THE ATMOSPHERE.

By W. H. DINES.

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In the supplements Nos. 10, 11, and 12 of the MONTHLY WEATHER REVIEW[1] a series of consecutive observations made with kites at Drexel, Nebr., is published. The observations were made by sending up kites in succession for about 30 hours, a fresh ascent being started soon after the last kite of the previous ascent had been drawn in. Thus on each occasion by utilizing both the ascent and descent some 10 observations of temperature at each height fairly well distributed in time were obtained.

From the charts published I have taken out by interpolation the temperatures at the surface (396 meters) at 1, 1.5, 2, 2.5, and 3 kilometers above mean sea level at three-hour intervals, and from the figures so obtained have calculated the amplitudes and phase angles of the daily variation at each height. The result is as follows:

Height.	First order components.		Second order components.		S. D.
	Amplitudes.	Time of max.	Amplitudes.	Time of max.	
	° C.		° C.		° C.
Ground	4.9	3.30 p. m.	1.3	1.30 p. m.	2.5
1.0 km	1.1	6.00 p. m.	0.4	7.00 p. m.	2.7
1.5 km	0.8	8.30 p. m.	0.1	5.30 p. m.	3.1
2.0 km	0.6	7.00 p. m.	0.1	7.00 p. m.	3.9
2.5 km	0.6	7.00 p. m.	0.2	8.00 p. m.	4.7
3.0 km	0.7	4.30 p. m.	.....	.....	4.9

On some of the days for which observations were available the non-periodic changes were so violent that I judged it best to omit them, and here and there a temperature has been extrapolated to make up the 24 hours required. The column headed S. D. gives the standard deviation* of the temperature at each height from the mean of each special day, i. e., from the mean of the actual day of the ascents, not from the mean of the data. The times given are the times of the maximum.

It is not easy to calculate the standard error of an amplitude, because the standard deviation of the observations is compounded of the casual deviation, the periodic change, and the non-periodic change, and this latter is large, reaching on the average about 5°C.; however, it seems plain that the casual error can hardly exceed 0.15, and hence that there is a genuine daily variation up to at least 10,000 feet with a maximum in the afternoon or early evening, and a range of about 2°F. In the second-order, or 12-hour, terms the amplitudes may well be casual, but the theoretical value of the casual error is the same for terms of all orders, and these amplitudes being of the same order as their casual error support the genuineness of the 24-hour terms which are four times as large.

[1] Washington, D. C., U. S. Dept. Agric., MONTHLY WEATHER REVIEW, SUPPL. 10-12, 1918.

*See MONTHLY WEATHER REVIEW, 1916, 44:510-512.—EDIT.

Since Drexel is nearly 0.5 kilometers above mean sea level and is not on an isolated hill, the values given for the lower heights must not be taken as valid for places of small elevation. How far 3 kilometers over Drexel may be equivalent to 3 kilometers over a place at mean sea level is an open question.

ON THE DIURNAL INCIDENCE OF MAXIMUM AND MINIMUM TEMPERATURES AT ESKDALEMUIR.

By A. CRICHTON MITCHELL.

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In connection with certain inquiries it became necessary to obtain data as to the manner in which the frequency of occurrence of maximum and minimum temperatures is distributed throughout the twenty-four hours of the day. For this purpose the Eskdalemuir records for the six years 1911–1916 were immediately available. The times of occurrence of maximum and minimum temperatures were tabulated by hours and months. From these tables, graphs were constructed showing the mean times of maximum and minimum temperature, the standard deviations, and the mean recorded sunshine by months and by years, also the total frequency of maximum and minimum temperatures in summer and winter.

As is to be expected, the times of maximum and minimum show the least deviation from the mean in summer, when solar heating dominates the weather, and the greatest in winter. For the maximum temperatures, the mean for the summer half year lies almost exactly at 2 p. m., and the standard deviation is 2.55; and for the winter the mean is an hour earlier, and the standard deviation, 5.85, more than double that for summer. For the minimum temperatures the corresponding figures are: Summer, 1:45 a. m., 2.79; winter, 1:30 a. m., 4.29. The hours of greatest frequency of maximum temperature are 1–2 p. m. in January, February, April, October, November, and December; 2–3 p. m. in March, May, June, and August; and 3–4 p. m. in July and September. It is an interesting commentary on the winter climate in Scotland that in January the frequency of maximum temperatures is almost as great from midnight to 1 a. m. as from 1 to 2 p. m., although it sinks to zero in mid a. m. and p. m. In order of frequency, 11 p. m. to midnight ranks third and 2 to 3 p. m. fourth in the 24 hours. In December the order of frequency is (1) 1–2 p. m., (2) mt.–1 a. m., and (3) 11 p. m. to mt. The hour of greatest frequency of minimum temperature is 11 p. m. to midnight in all months except December, when it is from midnight to 1 a. m. Secondary peaks of frequency of minimum temperatures range from 8–9 a. m. in December and January to 3–4 a. m. in June. Considering the cloudiness data, on the average, an increase of one-tenth in the amount of unclouded sky during the later hours of the day is accompanied by a postponement of the time of minimum temperature by about 40 minutes.—*C. F. B.*